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THE GULF ISLANDS
EXPEDITION OF 1966

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The Gulf Islands Expedition of 1966 was a joint venture by the California Academy of Sciences, and San Diego Natural History Museum, and the Instituto de Biología of Mexico. Thirteen scientists from those institutions participated in the 10-day cruise, 19-29 April, to 13 islands in central Gulf of California. The expedition was financed partly by a grant from the Belvedere Scientific Fund of San Francisco and partly from a National Science Foundation grant to the San Diego Natural History Museum.

The biogeography of the islands of the Gulf of California, and the systematic classification of the organisms of that region, have long interested scientists from the Academy and the Museum. Their most recent field work in that area includes the Belvedere Expedition of the Museum in 1962 (Lindsay, 1962) which visited 32 islands on a 43-day cruise; the Sea of Cortez Expedition of the Academy in 1964 (Lindsay, 1964; Orr, 1965), which worked the islands south of Loreto between 20 June and 4 July; and the Gulf of California Expedition in 1965 which from 9-20 August again concentrated on the southern area. In addition the personnel of the Natural History Museum carry on continuing investigations of the biota and geology of the region near the Museum's Vermilion Sea Field Station at Bahía de los Angeles, Baja California.

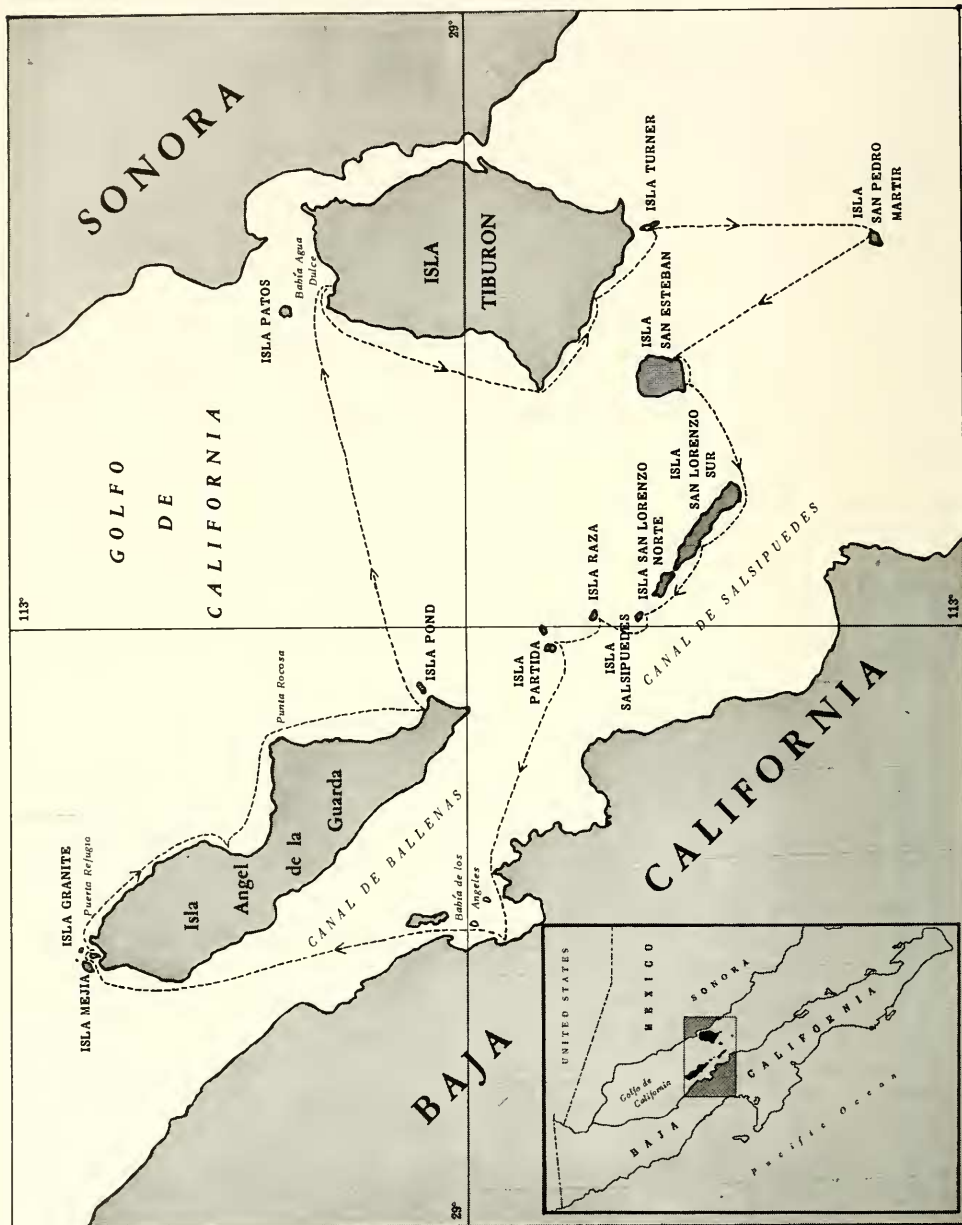


FIGURE 1. Route of *San Agustin II* to northern Gulf of California islands shown on expedition-route chart. (From Lindsay, *Pacific Discovery*, vol. 19, no. 5, p. 3, October, 1966.) (Drawn by D. Ludlow.)

Having concentrated on the southern Gulf of California during the previous two summers, Academy personnel were anxious to survey the islands of the central portion. Dr. Alejandro Villalobos F., Chief of the Hydrobiology Section of the Instituto de Biología, who participated in the two previous trips, was also interested in exploring farther north. The San Diego Natural History Museum was approached and agreed to co-sponsor an expedition. An 85-foot motor vessel, *San Agustin II*, belonging to Mr. Antero Diaz, of Bahía de los Angeles, was chartered. Mr. Diaz has supplied his vessel for several biological cruises, and he and his crew were most pleasant, cooperative, and helpful.

The scientific party included:

George E. Lindsay, Director, California Academy of Sciences
 Richard P. Phillips, Director, San Diego Natural History Museum, geologist
 Alejandro Villalobos F., Chief, Sección de Hidrobiología, Instituto de Biología, invertebrate zoologist
 Robert T. Orr, Associate Director, California Academy of Sciences, mammalogist and ornithologist
 Tom Tilton, Trustee of the California Academy of Sciences, observer
 Reid Moran, San Diego Natural History Museum, botanist
 Richard C. Banks, San Diego Natural History Museum, mammalogist and ornithologist
 Allan J. Sloan, San Diego Natural History Museum, herpetologist
 Dustin Chivers, California Academy of Sciences, invertebrate zoologist
 Virgilio Arenas F., Instituto de Biología, assistant to Dr. Villalobos
 Raymond Bandar, California Academy of Sciences, assistant to Dr. Orr
 Ken Lucas, California Academy of Sciences, collector
 Luis Baptista, California Academy of Sciences, collector.

It is felt that a brief narrative log and itinerary of this cruise may be of use to others who are interested in the Gulf of California. The scientific results of an expedition will appear, sooner or later, in diverse publications, and this is but a preliminary report.

The islands visited were:

Isla Angel de la Guarda, 19-22 April	Isla San Pedro Mártir, 25-26 April
Isla Mejía, 19-21 April	Isla San Esteban, 26-27 April
Isla Granite, 20-21 April	Isla San Lorenzo Sur, 27-28 April
Isla Pond (Isla Víbora, Isla Estanque), 22-23 April.	Isla Salsipuedes, 28 April
Isla Tiburón, 23-25 April	Isla Raza, 28 April
Isla Patos, 23 April	Isla Partida Norte (Cardonosa), 28 April
Isla Turner, 24-25 April	

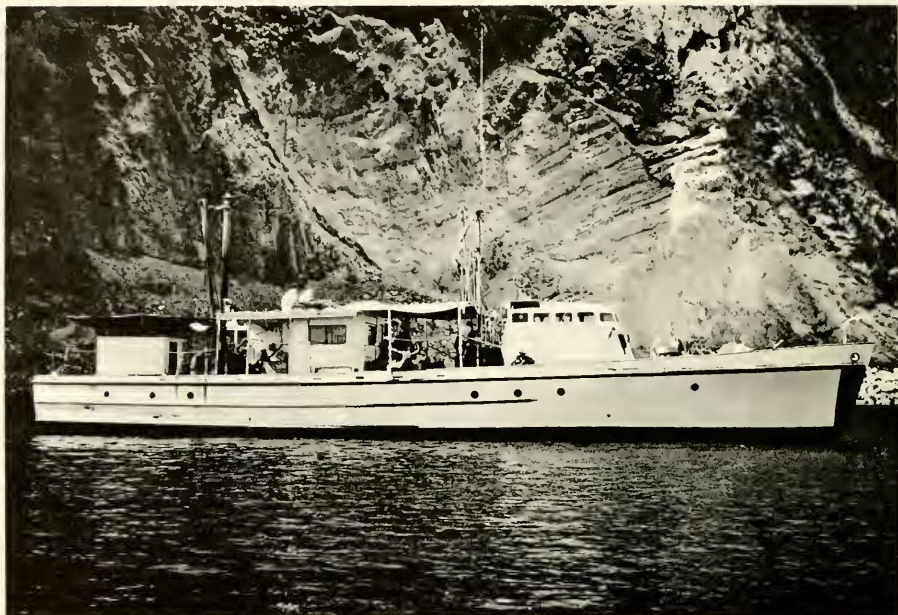


FIGURE 2. The 85-foot motor vessel, *San Agustin II*, was chartered for the expedition. (Photo by Tilton.)

LOG OF THE EXPEDITION

19 April 1966. San Francisco, California to Puerto Refugio, Isla Angel de la Guarda, Baja California.

Orr, Tilton, Chivers, and Bandar departed from San Francisco by air at 0700, and were met in San Diego by Phillips, Moran, Banks, and Sloan. At the Tijuana International Airport, they were joined by Villalobos and Arenas who had flown up from Mexico City. Victor Corral, one of the fine pilots that fly for the Servicio Aero Baja of Captain Francisco Muñoz, took the party to Bahía de los Angeles, where they arrived at 1145. Gear brought down by the scientists and equipment from the Vermilion Sea Field Station, maintained at Bahía de los Angeles by the Natural History Museum, were loaded aboard the *San Agustin II*, which after lunch departed for the north end of Isla Angel de la Guarda. Eight large finback whales were sighted in the distance in Ballenas Channel, and a school of many hundreds of dolphins, *Delphinus bairdii*, were about the boat for 15 or 20 minutes, swimming on either side of the bow, and often leaping clear of the water. The ship anchored between Isla Angel de la Guarda and Isla Mejía at dusk.

Isla Angel de la Guarda is 42 miles long, with a maximum width of about 10 miles. It is separated from Baja California by the Ballenas Channel which is about 8 to 13 miles wide. Tidal currents may reach a velocity of 6 knots in the channel (Roden and Groves, 1959).

This is a rugged island, with precipitous mountains which drop away into the sea, particularly on its west side. No permanent supply of fresh water is known on the island, but native palms (*Erythea armata*) in canyons on the east side may indicate possible sources. The island is not inhabited.

There is a fine bay at the north end, Puerto Refugio, formed by an indentation between two headlands, with additional protection from three small islands, Isla Mejía, Isla Granite, and a smaller one, about ½ mile long, which has no name.

Isla Mejía, which is at the northwest side of Puerto Refugio, is about 1 ½ miles long, 1 mile wide, and 850 feet high. Isla Granite, which protects the harbor from the north, is about 1600 yards long, 300 yards wide, and 281 feet high.

Banks and Bandar set small mammal traps on Isla Mejía after dark, and Sloan looked for reptiles. There was considerable luminescence in the water, and many sizable luminescent organisms were noted.



FIGURE 3. Bahía de los Angeles, Baja California. (Photo by Tilton.)

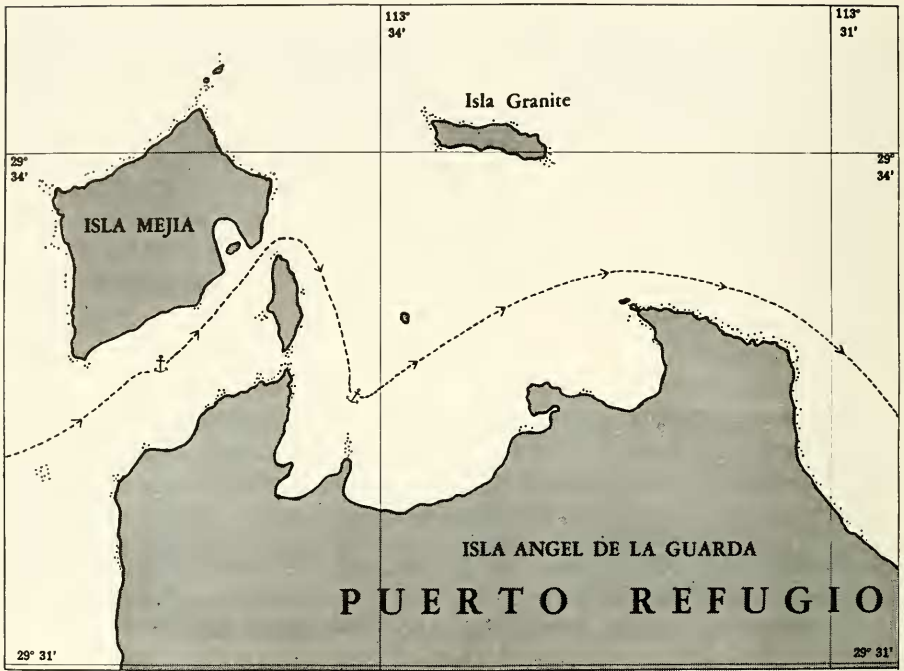


FIGURE 4. Detail of area showing north end of Isla Angel de la Guarda and adjacent islands. (Drawn by D. Ludlow.)

20 April 1966. Puerto Refugio.

Moran landed about 5 miles south of Puerto Refugio and climbed a 1100-meter (3600 feet) peak, which is perhaps the highest on Isla Angel de la Guarda. The opportunity to study the plants on this peak was his most important objective on the trip, and the day's work yielded seven additions to the known flora of the island. Perhaps the most interesting was *Leptodactylon pungens* ssp. *hallii*. He also saw *Idria columnaris*, which he had previously found on another high peak of the same island.

Phillips studied the geology of the west side of Isla Angel de la Guarda, about 12 miles from the north end. Here a "younger" sequence of volcanic flows, breccias, and sediments rest unconformably on massive andesitic and rhyolitic volcanics that make up the bulk of the mountains. A period of faulting is marked by a zone of intense hydrothermal alteration and silicification. These silicified rocks are included among the clasts in gently dipping conglomerates and sandstones which are truncated by coastal terraces which occur at an elevation of about 60 feet.

Orr, Banks, and Bandar landed on Isla Mejía to collect their traps before breakfast and took specimens of *Peromyscus guardia* and *Perognathus spinatus*. Then Orr and Tilton spent the morning on Isla Granite observing pelicans and sea lions. There were several thousand pelicans, mostly in great aggregations on points of rocks and beaches. Many nests were built of twigs and other debris, on rocks or fallen cardón cacti on the steep western slope of the island. The nests usually contained from one to three eggs, or one or two newly hatched naked young which could be heard calling 50 to 100 feet away. The brooding or incubating adults were rather timid and flew when approached closer than 20 or 30 feet.

Sloan was ashore on Isla Mejía at 0600 and took a good series of the endemic rock lizard (*Petrosaurus slevini*), as well as side-blotched lizards (*Uta stansburiana*) and chuckwallas (*Sauromalus hispidus*).

Villalobos and Arenas settled into their routine of the trip, which consisted of making plankton hauls with the small boat, intertidal collecting during periods of low water, processing their large collections, and frequent excursions ashore for nonmarine organisms. At Puerto Refugio, particularly, an intensive study of the intertidal ecological zonation was made, with collections of representative species of plants and animals, a full photographic record, and written descriptions. This area was later compared with the in-



FIGURE 5. Puerto Refugio, Isla Angel de la Guarda. (Photo by Orr.)



FIGURE 6. Robert T. Orr photographed ospreys on Isla Angel de la Guarda. (Photo by Tilton.)

tertidal areas at Estero de la Víbora near the south end of Isla Angel de la Guarda, at Bahía Agua Dulce on Isla Tiburón, on Isla San Esteban, and on Isla Salsipuedes.

Chivers made as complete a synoptic collection of the marine invertebrates as was possible, working in the intertidal zone during low water, and diving. Orr, Tilton, and others assisted him from time to time. The specimens taken were of unusual interest, because they complemented the collections from the southern area which Chivers had made in the summers of 1964 and 1965. The unique physical factors of great tidal range, strong currents, cold upwellings, and beach topography contribute to the development of quite different invertebrate assemblages from those found farther south. This northern area has many endemic species which were very poorly represented or were entirely lacking in the Academy collections.

Banks spent the morning on the main island, observing birds, and collected a Vaux swift, a new record. Mockingbirds with young were particularly common and conspicuous. Banks also collected an endemic rattlesnake (*Crotalus mitchelli angelensis*), as did Bandar.

Orr, Banks, and Bandar went to Isla Mejía in the late afternoon to set traps up one of the arroyos.

21 April 1966. Puerto Refugio to the south end of Isla Angel de la Guarda.

The mammalogists were ashore on Isla Mejía at daybreak, to collect their traps and catch. Banks found that one mouse, caught by its tail, had been swallowed by a snake up to the trap. Most of the party spent the morning on the main island, at the south side of Puerto Refugio. Moran worked Isla Mejía as well, but having been there previously, found little of particular interest. Orr and Tilton photographed an osprey nest, with the handicap of being the targets of disconcerting dives of the screaming parent birds, and recorded the unstable maiden flight and crash landing of one of the young ospreys.

Phillips worked the geology of the west side of Puerto Refugio, and found an extensive section of the "younger" volcanic sequence exposed, unconformably on top of metamorphic basement. His careful search failed to reveal any fossils in the volcanic sediments. Sea cliffs cutting into fanglomerate filled valleys, with no evidence of marine deposition, indicate recent subsidence of that area.

Phillips also found a "long-dead" dolphin on the beach, and Diaz took Orr, Tilton, and Bandar to investigate. It was identified as *Delphinus bairdii* and the skull was collected.

The anchor was lifted at 1250 and the party cruised along the east side of Angel de la Guarda. At 1500 a stop was made at a lagoon called Estero del Pulpito. Reddish egrets, elegant terns, and American oystercatchers were observed, and western gulls were nesting on the strand which separates the lagoon from the beach. The nests contained one to three eggs. Moran reported that the plants he found were predried, and Banks picked up a sea lion mummy.

Anchorage was made after dark in the broad Bahía Cardoncito, north and west of Isla Pond, which is also called Víbora and Estanque. Isla Pond is only about 1 mile long and 400 feet wide. After dinner, Bandar and Sloan went ashore on Isla Angel de la Guarda and collected a rattlesnake (*Crotalus ruber*), and two leaf-nosed bats (*Macrotus californicus*). The crew caught a turtle.

22 April 1966. Isla Angel de la Guarda and Isla Pond (Víbora, Estanque).

At 0650 Moran went ashore for a day on Angel de la Guarda. He walked west across the insular divide, climbed a low peak on the divide, and then followed a twisting arroyo southeasterly to the beach, arriving just before dark. He got two new plant records for the island on the barren-looking peak.

Phillips, too, spent most of the day on the big island, making a geological reconnaissance. He found a gently sloping surface rising from sea cliffs to at least 600 feet at the base of mountains some 2 miles inland. This surface is developed on coarse, well cemented conglomerate and sand-



FIGURE 7. Allan J. Sloan preserving a large rattlesnake, *Crotalus mitchelli angelensis*, from Isla Angel de la Guarda. (Photo by Lindsay.)



FIGURE 8. Reid Moran was the expedition botanist. (Photo by Lindsay.)

stone, with volcanic clasts. This grades into diorite-bearing conglomerate to the south. The land surface is stepped, which may represent faults, or terraces, as are now developing in the major streams of the area. To the southeast, this surface is in contact and apparently intertongued with marine beds containing oyster and pecten reefs that resemble the "Imperial formation" fauna of Pliocene age.

Most of the biologists spent the morning working Estero de la Víbora, a productive lagoon on Isla Pond, which provided some of the best intertidal collecting of the whole trip. Numerous marine snails, chitons, an octopus with her eggs (*Octopus digueti*), and other marine invertebrates were taken. A large and delicious rock oyster (*Ostrea angelica*) was particularly abundant, and the biologists and crew gathered these for food. Later Orr, Tilton, and some of the crew fished for the commissary, and caught garoupa and cabrilla.

Banks spent the morning on Isla Pond but found few birds. He captured one rattlesnake (*Crotalus ruber ruber*) and some fish-eating bats, which he exposed from loose rocks while searching for cone-nose bugs (*Triatoma*). The preparation and preservation of bird and mammal specimens required many hours of monotonous work every day. The time required for the preparation of specimens is a limiting factor and one must collect selectively.



FIGURE 9. Phillips, Baptista, Lucas, Chivers, Sloan, and Orr on the foredeck of the *San Agustin II*. (Photo by Lindsay.)

Bandar also worked Isla Pond, and found murrelet eggs under loose rocks while collecting bats and chuckwallas. Sloan was on the southern end of Isla Angel de la Guarda in the morning, and collected chuckwallas, gridiron-tailed, and whiptail lizards.

The ship was moved to the south side of Isla Pond in late morning, and at 1215 was "buzzed" by the aircraft bringing Lindsay, Lucas, and Baptista to join the expedition. Delayed by Academy business until then, the three flew to San Diego at 0700 on 22 April. There they were met by Captain Muñoz, who took them to the Tijuana International Airport. Pilot Victor Corral flew them to Bahía de los Angeles in a Beechcraft B-18. En-route they saw six finback whales just north of Bahía San Luis Gonzaga. The pilot obligingly flew over Puerto Refugio and down the east side of Isla Angel de la Guarda, looking for the ship, which was located at Isla Pond. He then flew directly to Bahía de los Angeles. There were also finback whales in the mouth of that bay.

Mrs. Diaz contacted the *San Agustin II* by radio, and at 1515 the biologists departed in a speedboat for Isla Pond, where they boarded the *San Agustin II* at 1645.

At dusk the ship was moved back to Bahía Cardoncito west of Isla Pond, and everybody went ashore on Angel de la Guarda for an oyster bake

and turtle barbecue. The turtle had been cooked in its half shells before an open fire for several hours. The oysters were placed on glowing coals, then raked out, and served with a slice of lime.

Some concern was felt for Moran, who had been gone all day, but he appeared an hour or so after dark, carrying a large endemic rattlesnake (*Crotalus mitchelli angelensis*), which he had brought for Sloan.

23 April 1966. Isla Pond to Bahía Agua Dulce, Isla Tiburón, and Isla Patos.

Banks was ashore on Isla Pond at daylight to pick up his traps, which contained one peromyscus and one damaged perognathus, both of which were new records for the island. The peromyscus probably belongs to a new subspecies. The ship departed for Isla Tiburón at 0615.

Isla Tiburón is the largest island in the Gulf of California, having a length of about 29 miles and an average width of approximately 15 miles. There are two or more mountain ranges, with peaks nearly 4000 feet high. The island is separated from the mainland by a shallow channel, El Infiernillo, only about a mile wide in some places. The plants and animals of Isla Tiburón are Sonoran in affinity, as would be expected.

Isla Tiburón has recently been declared a game preserve and put under the jurisdiction of the Patronato para la Conservación y Aprovechamiento de la Fauna Silvestre en el Estado de Sonora. Unauthorized visits to or collecting on the island are strictly prohibited. Permission for our activities was granted by Lic. Rene Martinez de Castro, President of the Patronato, on the condition that we first report to the Jefe de la Vigilancia at Bahía de Agua Dulce. Therefore we set course for the north end of the island.

Enroute some common dolphins, a finback whale, many northern phalaropes, 61 black petrels, and other animals were seen. Arriving at Bahía de Agua Dulce, Villalobos, Phillips, and Lindsay went ashore where they were met by an armed guard. Sr. Alfredo Topete, the Jefe de Vigilancia, was not then in camp but was expected in the evening. Permission to proceed with collecting was given.

Orr, Tilton, Lindsay, and Baptista decided to visit Isla Patos, four miles north of Tiburon, during the afternoon. This little island has one small granitic hill, 275 feet high, and considerable flat land. There were great masses of brown pelicans along the shore line. Orr walked around the island and estimated there were between 50,000 and 100,000 of those birds, but found no sign of nesting. Several hundred elegant terns occupied one end of a beach and some off-lying rocks, but were not nesting. Neither were several hundred Heermann's gulls at the north end of the island, although



FIGURE 10. Bandar, Orr, Baptista, and Banks examining small mammals which were trapped on Isla Tiburón. (Photo by Tilton.)

they seemed to have definite territories. They dove at Orr when he approached, as did some nesting western gulls. Baptista collected a fish-eating bat (*Pisonyxivesi*) from the tumbled walls of a rock building. Lindsay picked up an injured phalarope. Several pairs of Wilson's plovers were nesting under a shrubby chenopod (*Atriplex barclayana*) which was almost the only kind of plant on the island. There were also brown boobies, blue-footed boobies, Hudsonian curlews, ravens, white-crowned sparrows, rock wrens, a mourning dove, and a green and white Cessna 182 which had crashed two weeks earlier. The group returned to the ship at 1630.

Most of the party spent the afternoon on Isla Tiburón. Bahía Agua Dulce is at the mouth of a broad valley which separates two north-south mountain ranges. Phillips found the western range composed of volcanic rocks, primarily dacites, andesites, and basalts, similar to the "older" volcanic sequence of Angel de la Guarda, with overlying "younger" volcanics and associated sediments becoming prominent farther south. The eastern range is composed of quartz-diorite and intruded metamorphics. The northernmost point is white marble and intrusive quartz-diorite. Alteration and shearing are prominent, with silicification on the west side. The cliff cut in the fill of the broad valley between the ranges exposes marine beach de-

posits, probably of Pleistocene age, at the base of a 30-to 45-foot cliff.

Moran had collected at Bahía de Agua Dulce before, but most of the plants were lost in a fire. Although the vegetation was dry on the flats, he found a north slope which had interesting plants in good condition. His notes further state, "Although I don't usually risk impalement on cacti by chasing lizards, I couldn't resist a blue-green collared lizard and caught it twice." Gila woodpeckers were common, feeding noisy young in nests dug into cardon and saguaro cacti. Banks saw a pair of nesting red-tailed hawks, one of which was melanistic.

Sloan collected reptiles, and in the late afternoon Banks, Bandar, and Lucas set their small mammal traps. Villalobos, Arenas, and Chivers worked the intertidal area for invertebrate animals.

Bandar and Lucas erected an insect flight trap, which they had borrowed for the trip from Paul Arnaud of the Academy's Entomology Department. It was Arnaud's own modification of a Malaise flight trap and was made of nylon netting and shaped like an umbrella tent. It was so constructed that vanes within it intercepted flying insects and led them into a killing jar at its top. The simple trap was very effective, and many night-flying as well as day-flying insects were collected.



FIGURE 11. Sloan, Lucas, Lindsay, and Orr searching for reptiles at Ensenada de la Cruz, Isla Tiburón. (Photo by Tilton.)



FIGURE 12. Finback whales were seen frequently. (Photo by Tilton.)

24 April 1966. Isla Tiburón.

Banks, Bandar, and Lucas went ashore at 0500 to pick up their traps, and were accompanied by Orr, Chivers, Baptista, and Lindsay. They found they had taken representatives of *Neotoma labigula*, *Peromyscus eremicus*, *Perognathus arenarius*, and *Dipodomys merriami*.

Villalobos and Arenas were ashore, and learned that Sr. Topete had arrived during the night. Phillips and Orr joined them and gave Sr. Topete a manifest of the scientific crew. After a friendly meeting the party boarded the ship and departed for the south end of Tiburón at 0840.

While sailing down the west coast, finback whales were seen, as well as large numbers of phalaropes, and numerous brown boobies and brown pelicans. There were also many Craveri's murrelets, some elegant terns, and a few blue-footed boobies.

Anchorage was made at noon at Ensenada de la Cruz, on the south side of Isla Tiburón. A party of American tourists, with several outboard motorboats, were camped on shore. The tourists were puzzled by the ship and its crew's activities.

Phillips and Moran hiked inland. Bandar explored caves in cliffs, and

found human bones and charred woven matting which probably were ancient Seri Indian burials. Sloan captured a greenish rattlesnake (*Crotalus molossus*) in a cave, and Tilton caught a specimen of *Coleonyx variegatus*. Orr and Lucas set a trap line, then Lucas concentrated on scorpion collecting and found many under rocks and in wood rat nests. The endemic barrel cactus (*Ferocactus wislizenii tiburonensis*) was in full bloom.

Phillips reported that the oldest rocks at Bahía de las Cruces are rhyolites and rhyolite tuffs, similar to the "older" volcanics to the north, but more acid. These are cut by glassy rhyolite and banded silica, indicating acid igneous activity and extensive hot-springs deposition. He had sighted the same type of material from the ship on the northwest coast of the island. Overlying this is a section up to 50 yards thick, of reddish, medium indurated conglomerate with clasts of locally derived, rounded, volcanic rocks. No metamorphic or intrusive igneous rocks were noted in the clasts. Fossiliferous light-yellow tuffaceous sandstone lies unconformably over the rhyolite at the beach, and may be equivalent to this conglomerate.

Phillips caught a red racer (*Masticophis flagellum*) in a palo verde tree.

During the afternoon several finback whales swam past the boat, most of them traveling westerly. One circled and came within 200 feet. Villalobos found great quantities of euphausiid crustaceans during the night collecting, which may explain the presence of the giant whales so close to shore.

Banks and Baptista had gone to Isla Turner to set traps early in the afternoon, and had not returned after dark. The second boat was sent to see if they were in trouble, but it met them a few minutes out and all returned to the ship. Banks had captured a specimen of *Crotalus atrox* on Isla Turner.

25 April 1966. Isla Tiburón, Isla Turner, and Isla San Pedro Mártir.

At daylight Banks and Baptista returned to Isla Turner in a small boat, while Phillips, Bandar, and Lucas went ashore on Tiburon to check a geologic outcrop and to collect traps. As soon as they were aboard, the ship went to Isla Turner, where it anchored about half way down the west side. The small boats took the biologists to the east and more accessible side. Banks found that his traps contained specimens of *Peromyscus collatus* and a form of *Perognathus*, neither of which was represented in the Museum collection.

Isla Turner is only 1¼ mile long, ½ mile wide, and 550 feet high. None of our party had been there before, although it has frequently been visited by other biologists, particularly from the University of Arizona, who approached from nearby Sonora. In fact Phillips found a "snake stick," a device for handling live snakes which was made from the shaft of a golf club,

and two or three "museum special" mouse traps! Phillips caught a Sonora racer (*Masticophis bilineatus*) which made him the racer specialist of the expedition. Bandar took a rattlesnake (*Crotalus atrox*).

There were many birds on Turner. Baptista noticed a Costa hummingbird feeding at a cardon flower, verdins nesting in cactus, and three snowy egrets on the shore. Lindsay took motion pictures of ash-throated flycatchers taking food to their young in a cardon. The island had a comparatively thick cover of vegetation, and Moran took such plants as were in any condition for collecting and as far as possible listed the others. Villalobos, Arenas, Chivers, Orr, and Tilton concentrated on intertidal zone collecting, and found it the richest station of the expedition.

Phillips observed that the northern two-thirds of Isla Turner is composed of slates and banded quartzites, with some black marbles and thinly laminated and contorted anhydrites and marbles. These have been cut by rhyolite dikes. The southern third of the island is quartz-diorite.

At 1100 the ship departed for Isla San Pedro Mártir, which lies in the center of the Gulf about 20 miles south of Isla Turner, and anchored on its southeast side at 1330. San Pedro Mártir is a small triangular island less than 1 mile long and about 1050 feet high. Except for a heavy cover of cardon cacti which, from a distance, gives the top of the island the appearance of a piñon forest, it has little of botanical interest. There are two kinds of lizards on the island, *Uta palmeri* and *Cnemidophorus tigris martyris*, both of them endemic. The only snake found or reported is *Crotalus atrox*. There are no native land mammals, but there are introduced rats.

Most of the biologists went ashore as soon as the anchor was in place. Orr, Phillips, and Lindsay took a small boat around the island in order to take a census and study the sealion population, and to examine and sample the geology and petrology of the exposed sea cliffs. That was a beautiful trip. Most rock ledges and beaches were covered with sealions. A group of young ones raced along beside their boat, porpoising. When they stopped to take a rock sample, the sea lions waited, erect in the water, watching.

There were thousands of pelicans, too, on the rocks along the water. Unlike noisy gulls and terns, a great flight of pelicans gets into the air with only a swishing of wings.

San Pedro Mártir was formerly a guano island, because it is a giant rookery for blue-footed and brown boobies. The guano was harvested before the turn of the century, and the company which had the guano concession made great efforts to provide facilities for collecting new supplies as it was deposited. Terraces were built for the nesting birds, and parts of the island, with series of rock walls, look like Inca ruins.

Blue-footed boobies were nesting everywhere, from sea cliff ledges over the water to the top of the island. It was impossible to walk without

disturbing the parent birds and their downy young, some of which stood their ground and pecked at the intruders. Of those that stayed, quite a few regurgitated their fish dinners. Higher on the island brown pelicans were nesting, and there were a few brown boobies with young. There were many annoying gnats which bothered the birds and biologists.

Moran climbed to the summit, and finding no plants which he had not previously collected, claims to have taken a half-holiday, enjoyed the view, and made observations and notes about the cardon cacti. These are night-through-morning flowering cerei, and he found that matured buds placed in a paper bag opened well before those left on the plant, which waited for night-fall. The Mexican biologists, too, gave up the ocean for land work that afternoon. Villalobos and Lucas caught a large specimen of *Crotalus atrox* in a pelican nest area. Banks collected two tropic birds. These nested under huge rocks near the water, and soared high overhead, their long tail feathers streaming behind them.

Finback whales were very close to the ship. One mother and calf had to turn to avoid running into the anchored vessel. They were magnificent as they rose to the surface and exhaled with a loud puff.

Phillips, after circling the island in the small boat and hiking over it, reported that it is composed of lavender andesites and associated sandstones



FIGURE 13. Tilton and Orr photographing blue-footed booby birds on Isla San Pedro Mártir. (Photo by Lindsay.)



FIGURE 14. Blue-footed booby bird on Isla San Pedro Mártir. (Photo by Lindsay.)

and conglomerates. The steep sea cliffs reveal many unconformities, faults, and offsets of several hundred feet, and sudden changes of rock type laterally. Although local dips to the north were observed, the overall impression is of southerly dipping layers, offset and repeated by steep northerly dipping normal faults.

The night was warm. With darkness, the gnats which had plagued everyone on the island and aboard ship disappeared. The ship was anchored close to the beach, and the sea lions, which appeared to sleep most of the day, were very active and noisy. There was a constant roar which echoed from the cliffs. Sometime after midnight one of the crew turned the searchlight on the animals, and they protested all the louder.

26 April 1966. Isla San Pedro Mártir to Isla San Esteban.

Banks, Bandar, Baptista, and Lucas were put ashore at 0600 to pick up the traps that they had set the night before. Trapping on this island was particularly intense with the hope of disproving the report that there are no native land mammals on it. Only two specimens of *Rattus rattus*, probably introduced by the guano gatherers, were caught in the traps, and they were near the beach. Banks' traps, which were highest on the land, had not been sprung, but he caught a rattlesnake (*Crotalus atrox*) while picking them up.

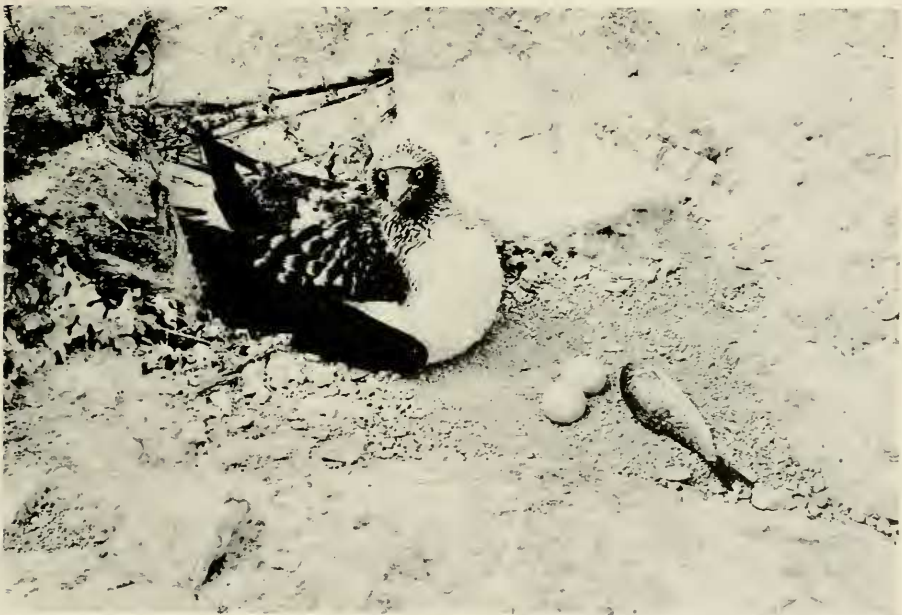


FIGURE 15. This blue-footed booby stayed with her nest, although her more timid mate regurgitated his fish and departed. (Photo by Lindsay.)



FIGURE 16. Brown pelicans nested on Isla San Pedro Mártir. (Photo by Lindsay.)

Orr, Tilton, and Chivers were also ashore. Chivers collected in the water until driven ashore by a belligerent bull sea lion.

All were aboard at 0845 and the run was made to Isla San Esteban, where anchorage was made off the mouth of a broad arroyo at the southeast side at 1145. San Esteban is about 4 miles long, north and south, and 3 miles wide and has a peak shown on charts to be 1772 feet high. It is an interesting island biologically, with several endemic animals.

Phillips and others had previously worked a rich Pliocene fossil deposit at the mouth of the arroyo, but he carefully resampled it, taking two types of echinoids, pectinids, coralline algae, and other material. He determined that the fossiliferous layer lies unconformably over the "older" volcanic rocks that make up the bulk of the island.

After a spirited chase, Sloan, Lindsay, and Tilton captured two spiny-tailed iguanas (*Ctenosaura hemilopha conspicuosa*) which they found resting high in an ironwood tree. A blotched chuckwalla (*Sauromalus varius*) was also taken. These two kinds of giant lizards are much less common than formerly, when they could be observed in great numbers along the arroyo banks. A series of old reptile can-traps were found in the bottom of the large arroyo. These were five-gallon cans, with tops removed, sunk to their brims in the soil. Such traps are used by some biologists to collect speci-

mens. However, many of those which were found had been abandoned without having been filled with dirt, so were acting as perpetual booby traps for lizards for no purpose whatsoever. All that could be found were filled with soil.

Lucas and Baptista collected some birds for Banks, concentrating on those that vary geographically, so that avifaunal relationships of the island could be re-examined. Lucas and Lindsay collected scorpions. Moran climbed to the peak near the northwest corner of the island, went down the north slope and to the west, crossed the divide into the head of the main arroyo, and got back to the beach at dusk. At the summit of the peak at about 1500 feet, both Moran and Phillips noted several semicircular to circular walls of loosely piled rock, built apparently by the Indians. These were about 2 or 3 feet high, each structure about 3 feet wide, the open ones facing alternately in opposite directions. Moran collected eight species of plants not previously listed for the island.

Bandar and Lucas put up the insect trap, and Lucas and Lindsay collected scorpions. Villalobos, Chivers, and Arenas worked the intertidal zone. A reptile search after dark was unproductive, but Sloan took a beautiful tarantula (*Aphonopelma* sp.).

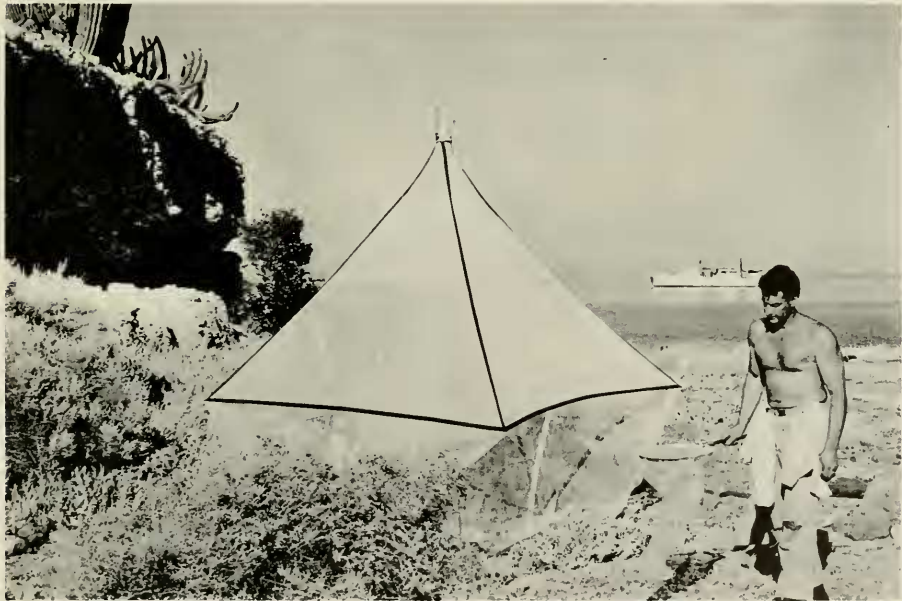


FIGURE 17. Bandar with the nylon insect flight trap on Isla San Esteban. (Photo by Orr.)

Large flocks of eared grebes were around the anchored ship most of the afternoon. One group of about 125 amused the biologists who were watching them. The grebes would duck under the water almost simultaneously; about $\frac{1}{2}$ minute later they would all bob to the surface at some other place, and $\frac{1}{4}$ or $\frac{1}{2}$ minute later they would disappear again, as if on some signal.



FIGURE 18. Marine invertebrate biologist Arenas examining jellyfish which he collected at Isla Salsipuedes. (Photo by Lindsay.)

27 April 1966. Isla San Esteban to Isla San Lorenzo Sur.

A party went ashore at 0545 to pick up traps, and for low tide collecting. Lucas continued to hunt birds for Banks. The insect tent-trap was struck, and all returned to the ship at 0745.

Orr and Bandar wanted to examine a long rock spit extending from the southwestern corner of the island, in the hope of finding bones of stranded cetaceans. The ship was anchored close to the spit and general collections were made for an hour. Forty or 50 pairs of western gulls were nesting on the spit, their nests nothing more than a little seaweed in a hollow in the coarse gravel. American oystercatchers made no nest at all, and simply deposited a single egg among the rocks.

Three young Mexican fishermen with a large canoe had stayed with the ship during the night, and were towed to Isla San Lorenzo Sur, where they were cast off in order for them to continue on to Puerto San Francisco on the peninsula. The ship proceeded north up the Salsipuedes Channel to near the center of the west side of Isla San Lorenzo Sur, where Phillips wanted to hike inland, and anchored at 1200 for the afternoon and night. The Islas San Lorenzo are two islands, Norte and Sur, separated by a narrow boat channel. Their combined length is $12\frac{1}{4}$ miles, and the southern island is 2 miles wide and 1590 feet high. With Isla Salsipuedes, which is a northern extension of an emergent mountain ridge, they form the east side of the Canal de Salsipuedes, which is notorious for its rapid tide flow.

As has been previously reported, there are thick deposits of gypsum on the island. Phillips climbed to the top of the ridge, and his notes state "Metamorphic basement rocks, consisting of schists, hornfels, and gypsiferous marbles. This is unconformably overlain by 'older' volcanics, which are in turn unconformably overlain by 'younger' volcanics and associated sedimentary rocks, in part marine. The upper unconformity is locally marked by the development of a thick section of gypsum. This sequence is repeated by faulting both north and south of here."

Moran crossed a low divide to the northeast side of the island. He collected four plants not previously recorded from the island. Sloan found an attractive and docile adult rattlesnake (*Crotalus ruber*) which lacked all but the proximal rattle segment. This was of particular interest. In the evening, collecting with lights, Bandar found a kingsnake (*Lampropeltis getulus*), which is probably the only living specimen ever collected on a northern Gulf island.

Chuckwallas (*Sauromalus hispidus*) were common. Large ones sunned themselves just outside of their burrows at the base of a cliff. Lucas picked one up while it was asleep in the sun on top of a cardon. These lizards often climb up trees and bushes while browsing. As was the case at many of the anchorages, a large nest with ospreys was on a cliff above the boat.

It was hot on shore and several of the biologists bathed and swam, but the water was very cold.

28 April 1966. Isla San Lorenzo Sur, Isla Salsipuedes, Isla Raza, Isla Partida, and Bahía de los Angeles.

The traps were collected at daylight and had good catches of *Peromyscus* and *Perognathus*. The ship departed for Salsipuedes and anchored there at 0820, for 1½ hours. There were several pairs of ospreys, and a pair of peregrine falcons flying about. Pelicans were nesting along the crest of the island, with western gulls standing by to steal their eggs or chicks.

The departure for Isla Salsipuedes was at 1025. A large finback whale was in the little cove and appeared to be within a very few feet of the rocky cliffs. Arriving at the southwest side of Isla Raza at 1115, everybody went ashore to observe and photograph the birds on this remarkable island.

Isla Raza is about ¾ mile long, ½ mile wide, and no more than 100 feet high. It is the principal nesting area for Heermann's gulls and elegant terns. For many years egg collectors have come during the nesting season, to collect eggs by the canoe load, for the markets of Santa Rosalia and Guaymas. In order to insure that the eggs were unincubated, the collectors de-



FIGURE 19. A valley on Isla Raza was covered with nesting Heermann's gulls, and at one side was a densely packed colony of elegant terns. (Photo by Orr.)



FIGURE 20. The nests of Heermann's gulls were quite evenly spaced, and occupied most parts of Isla Raza. (Photo by Lindsay.)

stroyed all that were there, and then gathered the fresh ones as they were laid. At first this was not serious, because there were many birds and comparatively few egg collectors, who filled their canoes and left the island before the birds stopped laying. In recent years, however, more and more men came, and extended their collecting period through the whole season of ovulation. The bird population collapsed.

Largely because of the interest of Lewis Wayne Walker, of the Arizona Sonora Desert Museum, attention was focused on this catastrophe. The Belvedere Scientific Fund of San Francisco sponsored expeditions for American biologists to investigate the situation, and then provided a substantial grant to encourage the Mexican Government to make a sanctuary of the island. This was done by Presidential decree on 30 May 1964.

The scientists were anxious to find out what effect that protection was having. On shore they were met by Eduardo G. F. Arrington, a biologist from Mexico City, and José L. Valazquez and Loreto Fuerte Amador, wardens, who were resident during the nesting season. Sr. Arrington estimated there were 80,000 Heermann's gulls, 40,000 elegant terns, and 7000 royal terns on the island at the time of our visit. His estimate is probably very conservative.



FIGURE 21. Elegant terns occupied dense colonies, surrounded by Heermann's gulls. (Photo by Lindsay.)

The Heermann's gulls were rather evenly spaced over all of the flat areas of the island. The main broad valley, several acres in extent, was populated by thousands of gulls, standing by their clutches of eggs, spaced about 3 feet apart. In the central portion of the island was a great mass of elegant terns, well over an acre in extent. They were much more closely packed than the gulls, and seemed nervous and were fluttering and giving grating cries. Near the edge of some parts of the colony were royal terns.

If the terns were startled they rose as a body into the air, and the gulls walked in and began to eat their eggs. The terns settled in waves, and the gulls retreated before them. It was a breathtaking sight.

The headquarters of the wardens, a concrete building built with funds from the Belvedere Scientific Fund grant, which was administered through the National Audubon Society, was visited. Sr. Arrington said that no egg collectors had attempted to visit the island, and that the birds were making a remarkable recovery. There were several tern colonies, and the gulls were everywhere. This was a fitting climax for a very interesting trip.

Departing from Isla Raza at 1345, the ship proceeded to Isla Partida, locally called Isla Cardonosa, which was the last island to be visited.

This is the type locality of the fish-eating bat (*Pizonyx vivesi*), which had been seen or heard at nearly every one of the stops. It is also a nest-

ing place of both least and black petrels, which were of special interest to Baptista. Bats and black petrels were abundant in the loose rocks of the talus slopes of the island. Antero Diaz took Orr, Tilton, and Lindsay around a small outer islet, Lobera Partida, to observe sea lions. Brandt cormorants were also abundant on the islet.

Phillips photographed a spectacularly developed columnar basalt exposure on the southeast side of Partida, and collected specimens from what he thought might be a Pleistocene bed of fossil turritellas in a low central divide between the two higher parts of the island.

The ship departed for Bahía de los Angeles at 1640, and arrived at 2000. All hands fell to, unloading gear. During this activity what was thought to be a yellow-bellied sea snake swam by, and Sloan tried to capture it from a small boat, but it escaped. The gear and collections were taken to the beach in small boats and then transported to the Vermilion Sea Field Station for sorting and packing. The last day had been very busy and many islands were visited, so Banks, Bandar, Lucas, and Baptista, who ordinarily spent several hours skinning specimens every day, worked at that job most of the night.

29 April 1966. Bahía de los Angeles to San Francisco.

After an early breakfast at Casa Diaz, Lindsay, Orr, Tilton, Villalobos, Lucas, Arenas, Bandar, and Baptista drove inland in the Museum Travelall in order to see the forest of cirios (*Idria columnaris*), and the other remarkable desert vegetation of the peninsula. The rest continued to pack their collections and equipment. Francisco Muñoz arrived with his Lodestar at 1140, and everything was put aboard while the party had lunch. They departed at 1320, leaving Moran behind to do a little more botanical work and to drive the Travelall to San Diego, where he arrived 4 May.

The plane landed at Tijuana International Airport at 1510, and was met by Museum personnel, who took the scientists to the San Diego Natural History Museum. Some of the San Francisco gear was left there for later pickup, and Phillips took Tilton, Orr, Lucas, Bandar, Baptista, and Lindsay to the airport. They arrived at the San Francisco International Airport at 1745.



FIGURE 22. The personnel of the Gulf Islands Expedition of 1966 at Bahía de los Angeles, Baja California, on April 29. From left to right: Arenas, Chivers, Phillips, Lucas, Orr, Lindsay, Villalobos, Bandar, Sloan, Baptista, Banks, Moran, Tilton, and pilot Muñoz.

REPORT OF THE SCIENTIFIC RESULTS

Even a very preliminary and necessarily superficial statement of the scientific results of the expedition may have a place in this narrative report in spite of the obvious disadvantage of attempting such a discussion before the material is worked up and the appropriate scientific papers are published. The sponsors of the expedition, and the various Mexican officials and departments that issued the permits under which the collections were made, should have a preview of the results as soon as possible. Specific information and detailed reports will be published in due time.

BOTANY

Dr. Reid Moran, Curator of Botany, San Diego Natural History Museum, is an authority on the flora of Baja California and the islands of the Gulf of California and off the west coast of Mexico. He served as botanist on the Sefton-Stanford Expedition to the Gulf of California in 1952, and on the Belvedere Expedition in 1962. He has collected the plants of Isla Socorro, made many collecting trips to Isla Guadalupe, and spent many months in the field in Baja California.

The following is an abstract of Dr. Moran's preliminary report:

PLANT COLLECTIONS FROM THE NORTHERN GULF ISLANDS, APRIL, 1966

On the trip of April, 1966, to the northern islands of the Gulf of California, sponsored jointly by the California Academy of Sciences and the San Diego Natural History Museum, I made 180 numbered collections of plants. Having visited all these islands except Turner at least once, most of them twice, and Angel de la Guarda several times, I carried a list for each island and so avoided collecting the common plants at the same localities as before.

Despite comparatively few man days of collecting, the floras of these islands are now fairly well known, aside from summer annuals. For the smaller islands of Salsipuedes, Raza, and Partida, with comparatively small floras, the perennials and spring annuals probably are mostly known. But on the larger islands, collecting continues to yield new records, if at a decreasing rate.

Our trip was too late for best collecting of spring annuals at low elevations, but it was timed better for plants of high north slopes. My best collecting was on a high peak near the north end of Angel de la Guarda and on a peak near the northeast corner of San Esteban. My collections added nine species to the known flora of Angel de la Guarda, bringing the total to about 197, and also included five species reported before but not collected. On

San Esteban, my collections added eight species, bringing the total to 84. Since my list for Tiburón is not up to date with the many recent collections of Richard Folger, additions to my list may not be significant.

Apparently no one has collected summer annuals on any of these islands unless on Tiburón. It would be interesting to visit any of them, but particularly the larger ones, about a month after a good summer rain. Also, the larger ones need further exploration in spring following good winter rains. In particular, the higher peaks in the northern part of Angel de la Guarda are likely to yield further interesting additions to the flora.

AFTER THE ISLANDS

29 April. After the rest of the expedition had headed for home, I spent several hours searching for flowers in a colony of *Castela* 3 miles north of the village of Los Angeles Bay. This shrub has been a puzzle to botanists for several years, since complete flowering material to permit identification and proper description had not been collected before. Only a few plants had flowers, and there were mostly few per plant; but I found enough.

30 April. For several years I have wanted to collect on Cerro Santa Marta, in the Sierra San Borja southwest of Los Angeles Bay. In June, 1962, I climbed the 5000-foot summit nearest the Bay, but the round trip from sea level left little time for collecting there and none for the peaks beyond. So a two-day trip was necessary.

At 0615 I started for the abandoned Santa Marta Mine at 3000 feet, with food and water for two days. After making camp, I collected locally and visited the Santa Marta spring, about 2 miles to the southwest, which had supplied water for the mine but was now dry.

1 May. Starting up the mountain at 0610, I visited each of the summits, collected many plants, started down at 1530, and reached the Station at 2030. Among the plants collected were four species which apparently have not previously been found south of the Sierra San Pedro Mártir, as well as several that I found only once or twice before in Sierra San Borja. This was one of the most productive days of this season's field work in Baja California.

2 May. After taking care of previous days' collections, I went to El Terminal to collect cytological and herbarium material for a man at Brigham Young University of what he supposes to be a new species of *Erigonum*.

3-4 May. I drove to San Diego, making a few collections and photographs en route.

Reid Moran
10 May 1966

ENTOMOLOGY

While this expedition did not carry an entomologist, some collections of insects were made. The Arnaud version of a Malaise trap was used whenever possible by Raymond Bandar. This device caught a large number of nocturnal as well as diurnal insects. Bandar also did general insect collecting from time to time. Ken Lucas concentrated on scorpions and other arachnids, taking 63 specimens of several species of three genera of scorpions, and he also collected insects, as did Luis Baptista and other personnel.

Dr. Villalobos collected insects and other land arthropods for his colleagues at the Instituto de Biología.

GEOLOGY

Dr. Richard P. Phillips, Director of the San Diego Natural History Museum, welcomed this opportunity to continue his studies of the geology of the islands of the north central Gulf of California. His remarks about specific areas which were visited on this trip are quoted in the body of the narrative report. His general statement concerning the geology of the region follows:

GEOLOGICAL FRAMEWORK OF THE GULF ISLANDS

The oldest rocks exposed on these islands are metamorphic, of undetermined age, including thinly laminated quartzite, anhydrite, and marble. This succession has been intruded by coarse-grained quartz-diorite. Unconformably over these crystalline basement rocks is a succession of volcanic flows, tuffs, and sandstones up to 1000 meters thick which constitute the bulk of the exposed rocks on the island. They may be divided into two sequences; the "older" volcanics tend to be massive or poorly bedded, sometimes showing flaggy parting, with complex internal structures, local unconformities and minor faulting. Steep dips, probably initial, are noted locally. These predominantly andesitic rocks are similar to the mid-Tertiary Comondu formation of the Baja California peninsula. The "younger" volcanics and associated sediments are rhyolite, andesite, and basalt flows and tuffs interbedded with considerable amounts of sandstones, conglomerates, and breccias, and some mudstone. The sediments are predominantly derived from the associated volcanic rocks. These "younger" volcanics are unconformable to the "older" volcanics, but may, in places be contemporaneous with them. They may be equivalent to the San Marcos formation of Durham, of lower Pliocene age. Locally, all older rocks are unconformably overlain by a succession of sandstones, conglomerates, and fanglomerates up to several hundreds of meters thick. On the basis of fossil re-

mains, these appear to be equivalent to the Imperial formation of California, and may be as young as upper Pliocene. Local uplifted Pleistocene beach deposits indicate a recent episode of emergence for some parts of some of the islands.

Richard P. Phillips

HERPETOLOGY

Mr. Allan J. Sloan, Curator of Herpetology, San Diego Natural History Museum, was in charge of the reptile collecting on this expedition. He served as herpetologist on the Sea of Cortez Expedition in 1964, the "Gringa" expedition earlier the same year, and has carried on extensive field work throughout the area. He recently published a review of the herpetofauna of the islands of the Gulf (in Soulé and Sloan, 1966). Other expedition members assisted Sloan by collecting unusual reptiles which they found while carry on their own activities. Mr. Raymond Bandar took some of the rarer reptiles for the Herpetology Department of the Academy, which were not represented on the expedition.

The following is from Mr. Sloan's report:

HERPETOLOGICAL RESULTS

A total of 166 specimens of reptiles and amphibians were collected on the islands and at Bahía de los Angeles. These specimens consisted of 9 frogs, 16 snakes, and 141 lizards.

Emphasis was placed on securing those reptiles reported from the various islands but not represented in our collections. The following were obtained and are new to the collection:

<i>Sauromalus hispidus</i>	Mejía	<i>Crotalus atrox</i>	Tiburón
<i>Masticophis flagellum</i>	Tiburón	<i>Crotalus molossus</i>	Tiburón
<i>Salvadora hexalepis</i>	Tiburón	<i>Uta stansburiana</i>	Patos

Significant additions to the collection include the following species, previously represented by one or only a very few specimens:

<i>Petrosaurus slevini</i>	Mejía
<i>Petrosaurus mearnsi</i>	Bahía de los Angeles
<i>Crotaphytus collaris</i>	Angel de la Guarda, Tiburón
<i>Crotalus ruber</i>	Angel de la Guarda, Pond, San Lorenzo Sur
<i>Sauromalus hispidus</i>	Pond, San Lorenzo Sur

<i>Cnemidophorus tigris</i>	Tiburón, San Esteban, San Lorenzo Sur, Salsipuedes
<i>Coleonyx variegatus</i>	Tiburón
<i>Crotalus atrox</i>	Turner, San Pedro Mártir
<i>Sauromalus varius</i>	San Esteban
<i>Phyllodactylus xanti</i>	San Esteban, San Lorenzo Sur, Salsipuedes
<i>Ctenosaura hemilopha</i>	San Esteban
<i>Uta stansburiana</i>	San Lorenzo Sur

Two new island records were obtained:

<i>Masticophis bilineatus</i>	Turner
<i>Lampropeltis getulus</i>	San Lorenzo Sur (California Academy of Sciences).

The racer occurs on nearby Isla Tiburón, and on the Mexican mainland. The king snake is the only living specimen of its kind (as far as I know) ever collected on a northern Gulf island.

Many colored pictures were taken to aid in studies currently in progress on the lizard genera *Petrosaurus*, *Uta*, *Callisaurus*, and *Cnemidophorus*.

Several adult female chuckwallas (of three species) were secured and returned alive in the hope that they will produce young at the San Diego Zoo.

LIST OF SPECIES OBTAINED

Mejía	Tiburón (Cont.)	San Esteban (Cont.)
<i>Petrosaurus slevini</i>	<i>Crotaphytus collaris</i>	<i>Uta stansburiana</i>
<i>Uta stansburiana</i>	<i>Sauromalus obesus</i>	San Lorenzo Sur
<i>Sauromalus hispidus</i>	<i>Masticophis flagellum</i>	<i>Cnemidophorus tigris</i>
Angel de la Guarda	<i>Salvadora hexalepis</i>	<i>Phyllodactylus xanti</i>
<i>Callisaurus draconoides</i>	<i>Crotalus atrox</i>	<i>Sauromalus hispidus</i>
<i>Cnemidophorus tigris</i>	<i>Crotalus molossus</i>	<i>Uta stansburiana</i>
<i>Crotaphytus collaris</i>	Turner	<i>Crotalus ruber</i>
<i>Sauromalus hispidus</i>	<i>Masticophis bilineatus</i>	Salsipuedes
<i>Crotalus mitchelli</i>	<i>Crotalus atrox</i>	<i>Cnemidophorus tigris</i>
<i>Crotalus ruber</i>	San Pedro Mártir	<i>Phyllodactylus xanti</i>
Pond	<i>Uta palmeri</i>	<i>Uta stansburiana</i>
<i>Sauromalus hispidus</i>	<i>Crotalus atrox</i>	Partida Norte
<i>Crotalus ruber</i>	San Esteban	<i>Uta stansburiana</i>
Tiburón	<i>Cnemidophorus tigris</i>	Patos
<i>Callisaurus draconoides</i>	<i>Ctenosaura hemilopha</i>	<i>Uta stansburiana</i>
<i>Cnemidophorus tigris</i>	<i>Phyllodactylus xanti</i>	
<i>Coleonyx variegatus</i>	<i>Sauromalus varius</i>	<i>Allan J. Sloan</i>

INVERTEBRATE ZOOLOGY

Dr. Alejandro Villalobos F., Jefe de la Sección de Hidrobiología del Instituto de Biología de la Universidad Nacional Autónoma de México, has been a member of our most recent three expeditions to the Gulf of California. Professor Virgilio Arenas F., Becario de la Sección de Hidrobiología, was Dr. Villalobos' assistant on the present trip. They were interested in all aspects of marine biology and made large collections for their institution.

Mr. Dustin Chivers, Technical Assistant, Department of Invertebrate Zoology, California Academy of Sciences, collected most of the marine invertebrate animals which were taken for the Academy. Mr. Chivers was also a member of the two previous expeditions which worked in the southern Gulf, and was pleased with this opportunity to obtain comparative material from the more northern area. Reports by Dr. Villalobos, Professor Arenas, and Mr. Chivers follow:

INFORME DE NUESTRAS ACTIVIDADES DURANTE LA EXCURSION AL NORTE DEL
GOLFO DE CALIFORNIA, ORGANIZADA POR LA CALIFORNIA ACADEMY OF SCIENCES,
BAJO LA DIRECCION DEL DR. GEORGE E. LINDSAY

La oportunidad que se nos brindó a miembros del Instituto de Biología para tomar parte en la expedición de la California Academy of Sciences, organizada para visitar entre el 19 y 29 de abril del año en curso, diversas localidades de la parte norte del Golfo de California, nos permitió llevar al cabo colectas de animales marinos en las localidades que fuimos visitando a lo largo de nuestro itinerario.

Durante los días 19, 20 y 21 de abril, en el puerto El Refugio, al norte de la Isla Angel de la Guarda, hicimos--desembarcos para examinar la zona litoral durante la baja mar. En la zona intercotidal (intertidal zone) hicimos colectas de diversos invertebrados marinos y pudimos observar una zonación ecológica muy aparente en la que se ponía de manifiesto una sucesión de *Sargassum*, *Calpomenia*, *Lactuca* con *Balanus* intercalados, después los *Balanus* solos y en la parte superior un balánidos del género *Tetraclita*. Hicimos muestreos cuidadosos y tomamos notas y fotografías de la zona, para hacer un estudio posterior o para ilustración de la cátedra de Ecología Marina. En la zona intercotidal de otras localidades pusimos el mismo interés, tales como Estero de la Víbora, al este de la Isla Angel de la Guarda; Agua Dulce, en el norte de la Isla Tiburón; en Isla San Esteban, Isla Salispuedes, Isla Rasa, etc., en donde observamos aspectos semejantes. Las diferencias consistieron en falta o sustitución de algunos miembros de las asociaciones.

En el curso de la expedición hicimos rastreos de plancton y las muestras obtenidas presentan aspectos muy diversos, hay predominio de fitoplancton en las del norte de Angel de la Guarda y sur de la I. Tiburón. La abundancia de zooplancton la pudimos apreciar en los muestreos nocturnos obtenidos en la parte sur de la I. Tiburón, con gran predominio de Euphausiáceos (Crustacea Malacostraca), justificando con esto la presencia de ballenas que posiblemente buscaban este tipo de alimento muy cerca de la costa. En la Isla Salsipuedes por el contrario, había abundancia de Mysidáceos (Crustacea Malacostraca).

La colecta en la zona intercotidal aprovechando la baja mar, nos produjo un interesante material de moluscos, equinodermos, crustáceos y otros invertebrados. Pusimos especial cuidado en la obtención de Porcelánidos (Crustacea Anomura), para estudios futuros.

La expedición nos dió además, la fortuna de poder apreciar en toda su magnificencia, las agrupaciones de aves marinas, leones marinos, delfines, ballenas y aves insulares. Este espectáculo, grandioso para un naturalista, nos dejará un recuerdo imborrable.

El material que hemos acumulado en nuestras colecciones, procedente del Golfo de California y colectado en las tres últimas expediciones, nos permitirá en futuro cercano hacer estudios que contribuirán al conocimiento de la Biología de la región.

Solo nos queda agradecer al Dr. George E. Lindsay las facilidades que periódicamente nos ofrece para formar parte de sus expediciones al Golfo de California.

Alejandro Villalobos F.

Virigilio Arenas F.

del Instituto de Biología de la

Universidad Nacional Autónoma de México

LISTS OF INVERTEBRATES COLLECTED

The collections made on this trip to the north central islands of the Gulf of California augment the material obtained on the Sea of Cortez Expedition in 1964, and another Academy trip in 1965, both of which were in the southern Gulf. The present collections are of unusual significance to this department, for the following reasons:

1. The more northern part of the Gulf has many endemic species and representatives of a number of them were collected.

2. Little marine collecting had hitherto been done in this region of the Gulf. Until 1961 only nine records of Molluscan collecting in the littoral zone have been reported from the general vicinity of our stations (McLean, 1961).

3. The unique physical factors (large tidal range, strong currents, cold upwellings, beach topography, etc.) contribute to far different invertebrate assemblages from those found farther south.

4. The department had few preserved invertebrate animals from the important Gulf islands which were visited on this trip.

Although the tides were not favorable at a number of stations and the intertidal environment in many areas was poor, some stations were extremely rich, and the total results of the trip were gratifying. A total of 486 lots from 19 stations have been processed and a few mixed lots remain to be sorted. A phylogenetic breakdown follows:

1. Porifera	23	6. Annelida	22
2. Coelenterata	8	7. Echinodermata	50
3. Sipunculoidea	5	8. Arthropoda	100
4. Echiuroidea	5	9. Tunicata	12
5. Bryozoa	11	10. Mollusca	250
		Total.....	486

INVERTEBRATE ZOOLOGY COLLECTING STATIONS

- D-35 Isla Angel de la Guarda - Puerto Refugio.
- D-36 Isla Angel de la Guarda - northeast side of island.
- D-37 Isla Angel de la Guarda - east side.
- D-38 "Cardoncito" - near southwest end of Isla Angel de la Guarda.
- D-39 Isla Pond.
- D-40 Southeast end of Isla Angel de la Guarda, opposite Isla Pond.
- D-41 Isla Tiburón, north end; Bahía Agua Dulce.
- D-41A Same as D-41.
- D-42 Isla Turner - northeast side.
- D-43 San Pedro Mártir - small islands of Tiburón.
- D-44 Southeast end of Isla San Esteban.
- D-44A Southwest end of Isla San Esteban.
- D-45 Isla San Lorenzo del Sur - southwest end.
- D-46 Isla Salsipuedes.
- D-47 Isla Raza - Lagoon on north side.
- D-47A Isla Raza - south side.
- D-48 Isla Partida.

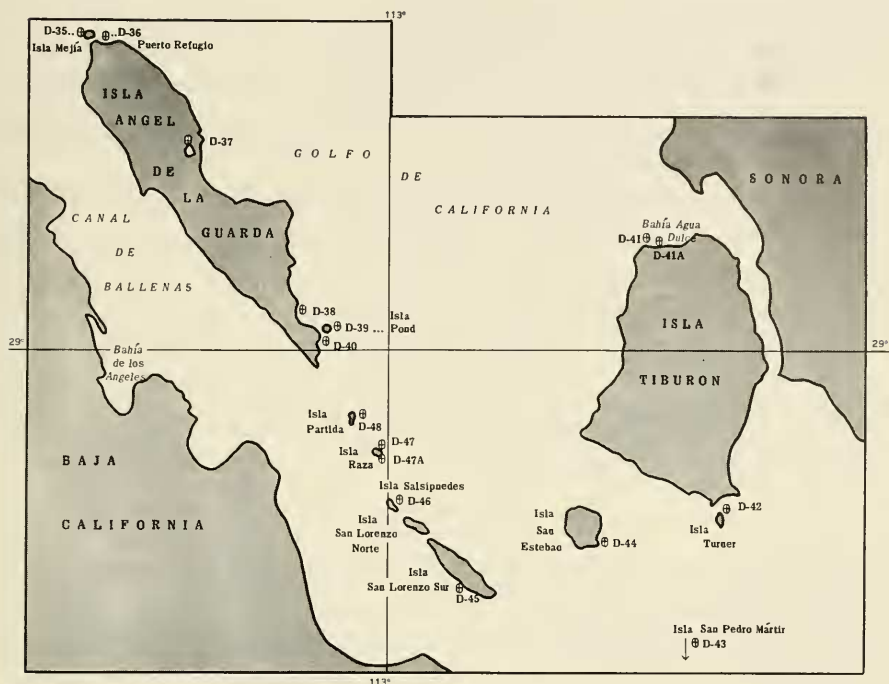


FIGURE 23. Chart showing collecting stations where marine invertebrates were taken. (Adapted from U. S. Hydrographic Office Chart No. 0620, July 17, 1963.)

CHITONS

Acanthochitona avicula (Carpenter, 1864), D-42, Isla Turner.

Acanthochitona exquisita Pilsbry, 1893, D-42, Isla Turner; D-35, Isla Angel de la Guarda; D-46, Isla Salsipuedes.

Basiliochiton lobium Berry, 1925, D-42, Isla Turner.

Callistochiton gabbi Pilsbry, 1893, D-42, Isla Turner; D-36, Isla Angel de la Guarda.

Callistochiton infortunatus Pilsbry, 1893, D-42, Isla Turner; D-39, Isla Pond.

Chaetopleura cf. *C. mixta* (Dall, 1919), D-42, Isla Turner; D-46, Isla Salsipuedes.

Chiton virgulatus Sowerby, 1840, D-41A, Isla Tiburón; D-35, Isla Angel de la Guarda; D-42, Isla Turner; D-48, Isla Partida; D-46, Isla Salsipuedes.

- Ischnochiton mariposa* Dall, 1919, D-41A, Isla Tiburón; D-42, Isla Turner.
Ischnochiton tridentatus Pilsbry, 1893, D-42A, Isla Tiburón; D-42, Isla Turner; D-48, Isla Partida; D-35, Isla Angel de la Guarda; D-39, Isla Pond.
Lepidozona clathrata (Reeve, 1847), D-41A, Isla Tiburón; D-35, Isla Angel de la Guarda; D-48, Isla Partida.
Lepidozona serrata (Carpenter, 1864), D-41A, Isla Tiburón; D-42, Isla Turner.
Leptochiton cf. *L. rugatus* Pilsbry, 1892, D-41A, Isla Tiburón; D-42, Isla Turner.
Nuttallina crossota Berry, 1956, D-48, Isla Partida.
Stenoplax conspicua sonorana Berry, 1956, D-41A, Isla Tiburón; D-42, Isla Turner.
Stenoplax limaciformis (Sowerby, 1832), D-41A, Isla Tiburón; D-42, Isla Turner.

GASTROPODS

- Acanthina angelica* I. Oldroyd, 1918, D-35, Isla Angel de la Guarda.
Acanthina muricata (Broderip, 1832), D-41A, Isla Tiburón.
Acanthina tuberculata (Sowerby, 1835), D-42, Isla Turner.
Acanthina tyrianthina Berry, 1957, D-35, Isla Angel de la Guarda; D-42, Isla Turner.
Acmaea turveri Hertlein and Strong, 1951, D-44, Isla San Esteban.
Anachis pygmaea (Sowerby, 1852), D-41A, Isla Tiburón.
Aplysia cf. *A. parvula* Guilding in Mörch, 1863, D-44A, Isla San Esteban.
Architectonica nobilis Röding, 1798, D-39, Isla Pond.
Assiminea sp., D-42, Isla Turner; D-44A, Isla San Esteban.
Berthella sp., D-35, Isla Angel de la Guarda; D-41A, Isla Tiburón.
Calliostoma angelenum Lowe, 1935, D-42, Isla Turner.
Cerithidea mazatlanica Carpenter, 1856, D-41, Isla Tiburón; D-47, Isla Raza.
Cerithium sculptum (Sowerby, 1824), D-35, Isla Angel de la Guarda; D-41A, Isla Tiburón.
Conus scalaris Valenciennes, 1832, D-35, Isla Angel de la Guarda.
Crepidula incurva (Broderip, 1834), D-41A, Isla Tiburón; D-42, Isla Turner.
Crepidula striolata Menke, 1851, D-41A, Isla Tiburón; D-42, Isla Turner.
Crucibulum spinosum (Sowerby, 1824), D-42, Isla Turner.
Cypraea annettae Dall, 1909, D-39, Isla Pond; D-42, Isla Turner.
Diodora inaequalis (Sowerby, 1835), D-39, Isla Pond, D-42, Isla Turner; D-44A, Isla San Esteban.

- Diodora saturnalis* (Carpenter, 1864), D-42, Isla Turner.
- Fissurella rugosa* Sowerby, 1835, D-44A, Isla San Esteban.
- Glossodoris californiensis* (Bergh, 1879), D-42, Isla Turner.
- Haminoea strongi* Baker and Hanna, 1927, D-35, Isla Angel de la Guarda; D-44A, Isla San Esteban.
- Hipponix pilosus* (Deshayes, 1832), D-42, Isla Turner.
- Jeffeysia* sp., D-42, Isla Turner; D-44A, Isla San Esteban.
- Jenneria pustulata* (Solander, 1786), D-36, Isla Angel de la Guarda.
- Littorina pullata* Carpenter, 1864, D-35, Isla Angel de la Guarda.
- Mitra tristis* Broderip, 1836, D-41A, Isla Tiburón.
- Mitrella lalage* Pilsbry and Lowe, 1932, D-41A, Isla Tiburón.
- Mitrella ocellata* (Gmelin, 1791), D-48, Isla Partida.
- Morula ferruginosa* (Reeve, 1846), D-36, Isla Angel de la Guarda; D-41A, Isla Tiburón.
- Nerita funiculata* Menke, 1861, D-47, Isla Raza.
- Nerita scabricosta* Lamarck, 1822, D-41, Isla Tiburón.
- Nomaeopelta mesoleuca* (Menke, 1851), D-41A, Isla Tiburón.
- Onchidiella binneyi* (Stearns, 1893), D-41, Isla Tiburón.
- Parametaria dupontii* (Kiener, 1849-1850), D-39, Isla Pond.
- Parametaria* sp., D-36, Isla Angel de la Guarda.
- Pyrene fuscata* (Sowerby, 1832), D-36, Isla Angel de la Guarda; D-41A, Isla Tiburón.
- Tegula* cf. *T. corvus* (Philippi, 1849), D-39, Isla Pond; D-44A, Isla San Esteban.
- Tegula globulus* (Carpenter, 1856), D-41A, Isla Tiburón.
- Tegula ligulata* (Menke, 1850), D-39, Isla Pond.
- Tegula mariana* Dall, 1919, D-35, Isla Angel de la Guarda; D-39, Isla Pond; D-42, Isla Turner.
- Tegula rugosa* (A. Adams, 1853), D-41, Isla Tiburón.
- Terebra specillata* Hinds, 1844, D-41, Isla Tiburón.
- Thais biserialis* (Blainville, 1832), D-45, Isla San Lorenzo del Sur.
- Thais triangularis* (Blainville, 1832), D-45, Isla San Lorenzo del Sur.
- Tridachiella diomedea* (Bergh, 1894), D-36, Isla Angel de la Guarda.
- Trivia radians* (Lamarck, 1810), D-39, Isla Pond.
- Trivia solandri* (Sowerby, 1832), D-36, Isla Angel de la Guarda; D-42, Isla Turner.
- Turbo fluctuosus* Wood, 1828, D-41, Isla Tiburón; Isla Turner.

PELECYPODS

- Anomalocardia subimbricata tumens* (Verrill, 1870), D-39, Isla Pond.
Arca mutabilis (Sowerby, 1833), D-42, Isla Turner.
Arcopsis solida (Sowerby, 1838), D-35, Isla Angel de la Guarda; D-41A, Isla Tiburón.
Barbatia reeveana (Orbigny, 1846), D-39, Isla Pond.
Carditameria affinis (Sowerby, 1833), D-39, Isla Pond; D-41, Isla Tiburón; D-42, Isla Turner; D-46, Isla Salsipuedes.
Chama squamuligera Pilsbry and Lowe, 1932, D-41A, Isla Tiburón.
Hiatella arctica (Linnaeus, 1767), D-39, Isla Pond.
Hormomya adamsiana (Dunker, 1887), D-35, Isla Angel de la Guarda; D-41A, Isla Tiburón; D-46, Isla Salsipuedes.
Isognomon chemnitzianus (Orbigny, 1853), D-39, Isla Pond; D-46, Isla Salsipuedes; D-47, Isla Raza.
Isognomon janus Carpenter, 1856, D-39, Isla Pond; D-41A, Isla Tiburón.
Lima tetrica Gould, 1851, D-36, Isla Angel de la Guarda.
Lithophaga aristata (Dillwyn, 1817), D-36, Isla Angel de la Guarda.
Lyonsia sp., D-42, Isla Turner.
Modiolus capax (Conrad, 1837), D-36, Isla Angel de la Guarda.
Pododesmus cf. *P. pernoides* (Gray, 1853), D-39, Isla Pond.
Protothaca grata (Say, 1831), D-41A, Isla Tiburón.
Semele sp., D-41, Isla Tiburón.
Thracia curta Conrad, 1837, D-42, Isla Turner.

CEPHALOPODS

- Octopus* cf. *O. bimaculatus* (Verrill, 1883), D-39, Isla Pond.
Octopus digueti Perrier and Rochebrune, 1894, D-39, Isla Pond.
Octopus sp., D-36, Isla Angel de la Guarda.

Dustin Chivers

ORNITHOLOGY AND MAMMALOLOGY

Dr. Richard C. Banks, then Curator of Birds and Mammals of the San Diego Natural History Museum and now with the United States Fish and Wildlife Service, has investigated the island fauna of the Gulf of California during the last six years, starting with a detailed study of the birds of Isla Cerro (Banks, 1963). He was a member of the Museum's Belvedere Expedition to all of the major islands in 1962, and visited the islands between San

Diego, California, and Isla Carmen while on the research vessel *Gringa*, now *Sea Quest*, in 1963. He was with the Sea of Cortez Expedition in 1964.

Dr. Banks' informal report, which was not submitted for publication, is reproduced here:

19 April. Proceeded from San Diego to Tijuana to Bahía de los Angeles, to Puerto Refugio, between Islas Angel de la Guarda and Mejía. Set traps on Mejía after dark. Pocket mice were very abundant, and Sloan and I had four before returning to the boat. They were particularly common in the weeds on flat ground, less so in the rocky canyons.

20 April. Had several other specimens of *Perognathus* in the traps, and one of *Peromyscus*. Spent the morning on Angel de la Guarda, observing birds and found two rattlesnakes. Mockingbirds, with young, were particularly common and conspicuous. There was a large flock of white-crowned sparrows, most apparently of the "*leucophrys*" rather than of the "*gambelli*" type. Collected a Vauz swift, a record for the island. Skinned in afternoon, until late, when I set traps again on Mejía.

21 April. Again had good supply of *Perognathus* specimens to skin, but none of *Peromyscus*. One mouse in the trap, caught only by tail, had been swallowed by a snake up to the trap. Spent a couple of hours on Angel in the morning. Moved south along Angel in early afternoon, stopping at a lagoon on east side, where I picked up a mummy of a sea lion and counted gull eggs in the nests. Anchored farther south at dark. Sloan and Bandar went ashore for snakes, and found bats (*Macrotus*) using chuckwalla burrows as night roosts. Collected two, which are island records.

22 April. Got to Isla Pond early in morning, and I spent until noon ashore there. Virtually no birds. Captured one rattler for Sloan, and dug in rocks for kissing bugs (*Triatoma*) for Ray Ryckman. Saved two specimens of *Pizonyx*, one skeleton and one alcoholic, which I found during the latter activity. Skinned during afternoon, going ashore late to set mouse traps. Pocket mouse signs were fairly abundant here, even though no mice were reported from the island. Turtle barbecue on beach.

23 April. Ashore early to pick up traps; had one peromyscus and one damaged perognathus. Both are new records for the island, and the peromyscus probably belongs to a new subspecies. Departed for Tiburón, going ashore on north end, Bahía Agua Dulce, in early afternoon. Gila woodpeckers common, feeding young in nests in cardons. Cactus wrens also common. Saw red-tailed hawk paid at nest, one of adults was melanistic. Saw *Citellus grammurus*, but unable to obtain one. Found a series of caves which bats use at night, and a wild bee colony in one. Set traps just before dark, putting rat traps as well as mouse traps.

24 April. Got a late start from here although we went ashore to check traps in a hurry. Had six wood rats, one dipodomys, one perognathus, and one specimen of *Peromyscus eremicus*. Went to south end of Tiburón, then took small boat to Isla Turner to trap. Caught a rattlesnake (*Crotalus atrox*). Saw abundant pocket mouse signs.

25 April. Picked up traps, finding specimens of *Peromyscus collatus* (new to museum collection) and three perognathus, probably belonging to *P. penicillatus*, not previously reported from the island. It is probably an undescribed form. No wood rats, unfortunately. Went back ashore after breakfast, but accomplished little. Departed for Isla San Pedro Mártir. Arrived in early afternoon, but did not go to shore until late afternoon. Hiked to near the top of the island to set traps. Many blue-footed boobies nesting, and also some tropic birds. Collected three of the latter for special investigation--adults as alcoholic and skeleton, a chick from one of them. The other had an egg. Took a dead baby pelican from a nest.

26 April. Had nothing in traps, but caught a rattler while checking them. Took some photos of boobies. Moved on to Isla San Esteban. Hiked a good ways in mid-afternoon, but it was the wrong time of day for birds. Black-throated sparrows were carrying food to nestlings here, and one juvenile was collected. Set traps late in afternoon, mostly near large clumps of cactus on a slope.

27 April. Had two mice (*Peromyscus stephani*) and four small rats (*Rattus*) in my traps. One of the mice had a crushed skull. Got a total of about 13 birds here, with the help of Ken Lucas, concentrating on those that vary geographically, so that the avifaunal relationships of the island could be re-examined. Moved from here to Isla San Lorenzo Sur. Spent a little time ashore in late afternoon, setting a few traps. Went back ashore in the evening, to look for snakes, and took one mouse from traps.

28 April. Early in morning moved on up to Isla Salsipuedes, where a pair of peregrine falcons were flying about the anchorage. I spent a couple of hours roving around the south end of the island trying to find their nest, but only found a place where I thought they were keeping house. Found a raven nest. Moved from here to Raza, where we spent a couple of hours ashore looking at the Heermann gulls and elegant and royal terns. What a bird colony! The terns particularly were packed about as tightly as possible in the space they occupied. Whenever they flushed, the gulls were there to eat eggs, and they seemed to be selective about the eggs they took. From here we went on to Isla Partida, where Luis Baptista and I searched the rocks for fish-eating bats and petrels. We found a number of bats, and quite a few black petrels, the latter with eggs, but no least petrels. From here we returned to Bahía de los Angeles, arriving after dark; unloaded the boat, and prepared a few last remaining specimens.

29 April. Spent the morning organizing gear and packing. About noon Sloan and I visited the springs for the town, and he collected some frogs. I picked up a dead yellow bat next to one of the springs, the second specimen of this species in our collection and a good record for the area. Flew back to Tijuana in early afternoon, and arrived back at museum about 1630.

Highlights of trip: Birdwise, the high spots were seeing the large flocks of migrant water birds--Arctic loons, eared grebes, and northern phalaropes, and, of course, the nesting colonies of gulls, terns, and boobies. Getting the tropic birds was quite exciting, and may prove to be good material with which to review the relationships of this group. The Gila woodpeckers from Tiburón may help to clarify the validity of that race, which I have previously questioned. The birds from Isla San Esteban should help in a reconsideration of the avifaunal relationships of that island--Van Rossem placed it with the Cape region, which is geographically improbable.

From the mammal standpoint, the addition of *Peromyscus collatus* to the collection was nice. Similarly, the finding of pocket mice on Isla Turner, pocket mice and *Peromyscus guardia* on Isla Pond, which have not been reported. The seeming absence of native rodents on Isla San Pedro Mártir is interesting. Reports of rats and mice on Isla Raza is confirmed by specimens taken by a student there. There was what appeared to be a pocket mice sign on Isla Partida, but we had no chance to trap. I was disappointed in *Peromyscus* trapping--but I did succeed in getting alcoholic males of five populations (four species) to send to Michigan for study of the glans penis and relationships.

A total of 79 specimens was obtained, all valuable. I consider the trip to have been very successful.

Richard C. Banks

The Academy's Department of Ornithology and Mammalogy was represented by its Chairman, Dr. Robert T. Orr, who was assisted by Raymond Bandar, Field Associate, and Luis Baptista, a graduate student at the University of San Francisco. Effort was made to secure representative collections of small mammals from all the islands where the *San Augustin II* anchored overnight.

Dr. Orr's primary interest was to continue his population studies on the California sea lion (*Zalophus californianus*) in the Gulf of California, which were begun in the summer of 1965. A report on this is planned for the near future. Studies were also made on cetaceans and marine birds. Mr. Bandar, in addition to collecting small mammals, participated actively in collecting reptiles for the Academy's Department of Herpetology and for Steinhart Aquarium. Mr. Baptista also collected small mammals and assisted Dr. Banks in his work on birds.

ACKNOWLEDGMENTS

The Gulf Islands Expedition of 1966 was sponsored by the Belvedere Scientific Fund of San Francisco, and by the National Science Foundation through its support of the Vermilion Sea Field Station of the San Diego Natural History Museum.

The scientific collections were made with the permission of various officers and officials of Mexico. The generous help and cooperation of the following gentlemen is particularly appreciated. Marine collections were made under permits signed by C. Biol. Rodolfo Ramirez Granados, Subdirector of the Dirección General de Pesca e Industrias Conexas, de la Secretaría de Industria y Comercio. C. Lic. Noe Palomares, Subsecretario de Agricultura y Ganadería, personally arranged for permits to collect plants and for additional courtesies from his offices. C. Dr. Rodolfo Hernandez Corzo, Director General de la Fauna Silvestre de la Secretaría de Agricultura y Ganadería, issued the permits for taking land animals. Permission to land and collect on Isla Tiburón was granted by C. Lic. Rene Martinez de Castro, Presidente, and C. Ing. Luis Carlos Felix, Secretario, of the Patronato para la Conservación y Aprovechamiento de la Fauna Silvestre en el Estado de Sonora.

Specimens destined to the San Diego Natural History Museum were taken under the appropriate permits granted to Dr. Richard P. Phillips, Dr. Richard C. Banks, Dr. Reid Moran, and Mr. Allan J. Sloan. Specimens for the California Academy of Sciences were collected under the permits of its Director, Dr. George E. Lindsay.

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